REPORT RESUMES

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THE EFFECT OF A STUDY OF TRANSFORMATIONAL GRAMMAR ON THE WRITING OF NINTH AND TENTH GRADERS.

BY- BATEMAN, DONALD R. ZIDONIS, FRANK J.
NATIONAL COUNCIL OF TEACHERS OF ENG.,CHAMPAIGN,ILL
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AN EXPERIMENT WAS CONDUCTED, OVER A 2-YEAR PERIOD, AT THE OHIO STATE UNIVERSITY SCHOOL TO TEST THE POSSIBLE EFFECTS OF A STUDY OF A GENERATIVE GRAMMAR ON STUDENT COMPOSITIONS. IN ADDITION TO THE REGULAR CURRICULUM, AN EXPERIMENTAL CLASS OF 50 NINTH-GRADERS (AND 10TH-GRADERS THE FOLLOWING YEAR) WAS REQUIRED TO LEARN TRANSFORMATIONAL-GENERATIVE GRAMMATICAL MATERIALS PREPARED BY THE INVESTIGATORS. SAMPLES OF WRITING BY BOTH THE EXPERIMENTAL AND CONTROL CLASSES WERE COLLECTED DURING THE FIRST 3 MONTHS OF THE PROJECT, AND IN THE LAST 3 MONTHS OF THE 2-YEAR PERIOD. THESE WERE ANALYZED FOR (1) STRUCTURAL COMPLEXITY, (2) THE PROPORTION OF WELL-FORMED TO MALFORMED SENTENCES, AND (3) THE TREND IN THE FREQUENCY AND KINDS OF MISOPERATIONS THAT OCCURRED. RESULTS OF THIS ANALYSIS INDICATE THAT KNOWLEDGE OF GENERATIVE GRAMMAR (1) ENABLES STUDENTS TO INCREASE SIGNIFICANTLY THE PROPORTION OF WELL-FORMED SENTENCES IN THEIR WRITING, (2) SEEMS TO ENABLE STUDENTS TO INCREASE THE COMPLEXITY WITHOUT SACRIFICING THE GRAMMATICALITY OF THEIR SENTENCES, AND (3) CAN ENABLE STUDENTS TO REDUCE THE NUMBER OF ERRORS IN THEIR WRITING. BECAUSE THE LOGIC OF GENERATIVE GRAMMAR SEEMS TO REPRESENT THE PSYCHOLOGICAL PROCESS OF SENTENCE FORMATION, ITS STUDY HELPS THE STUDENT OVERCOME THE DIFFICULTIES OF WRITING WITH GRAMMATICAL EFFECTIVENESS. (THIS REPORT--A CONDENSATION OF THE FINAL REPORT FOR COOPERATIVE RESEARCH PROJECT NO. 1746 (SEE ED 001 241.)--IS ALSO AVAILABLE FOR $1.00 FROM THE NATIONAL COUNCIL OF TEACHERS OF ENGLISH, 508 SOUTH SIXTH STREET, CHAMPAIGN, ILLINOIS 61820, ORDER NO. 14709.) (DL)

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By Donald Bateman and Frank Zidonis

TE 000 372

National Council of Teachers of English 508 South Sixth Street, Champaign, Illinois 61820

QUESTIONS ASKED BY THIS STUDY

. . . Can high school pupils apply transformational rules of a generative grammar in their writing?

. . . Can high school pupils increase their repertoire of grammatical structures by a study of generative grammar?

. . . Will the proportion of well-formed sentences increase in pupil writing in ninth and tenth grades?

. . . What kinds of transformational errors will occur in pupil writing? Will they increase or diminish over the two years?

National Council of Teachers of English

Research Report No. 6

The Effect of a Study of Transformational Grammar on the Writing of Ninth and Tenth Graders

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THE EFFECT OF A STUDY OF TRANSFORMATIONAL GRAMMAR ON THE WRITING OF NINTH AND TENTH GRADERS

DONALD R. BATEMAN

FRANK J. ZIDONIS

The Ohio State University

NCTE Research Report No. 6

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Among the questions which teachers of English most frequently ask are those which revolve about the teaching of grammar. Why teach grammar? Which grammar? Will teaching of grammar result in improved writing? By what criteria can such improvement in writing be measured?

If these questions had been asked a decade and a half ago, the answers would have been that grammar should be taught to improve writing (among other things); that the grammar to be taught was a brand of "functional grammar" which was traditional grammar sliced another way; that there seemed to be an inconclusive relationship—or perhaps, a lack of relationship—between the grammar taught and the supposed improvement in writing; that the criteria for assessing improved writing abilities were difficult to specify and more difficult to apply.

Within the last fifteen years, however, the profession has witnessed the rapid development of structural grammar and, more recently, transformational grammar. To be sure, the developments in these two grammars had their roots in much earlier scholarly studies; only within the last ten years, however, has either of the two systems had any wide currency.

With these new developments in the study of the structures of language has come the need to raise the same old questions. For it is the proper province of research to bring new evidence to bear on old questions or to ask the old questions in more searching ways. When the whole substance of a field such as grammar is as drastically altered as it has been of late, it is time to pose the old questions again.

Bateman and Zidonis outline in this study the most critical of all questions which most English teachers ask of transformational grammar—can students apply the transformational rules of a generative grammar in their writing? Will the students taught such transformational rules increase in ability to use a variety of sentence structures?

In seeking the answers to these questions, the investigators have steered clear of what they consider extraneous matters—class size, use of lay readers, frequency of writing, etc., and instead concentrate on what they suggest is the heart of successful composition teaching: the need for the composition teacher to have something to teach—to have something of value in the lessons taught in the composition classroom.

The answers which the authors suggest for the questions about grammar teaching are outside the tradition of much educational research. That is, the authors *did* find that there were differences between the experimental and control groups. The students in the experimental group *did* increase the proportion of well-formed sentences they wrote; they did write increasingly more complex sentences, and they did so without sacrificing grammaticality.

Bateman and Zidonis have performed a valuable service in this research. If other studies can be replicated with larger groups in different settings with similar results, the door *will* be open to much more effective use of transformational grammar. In any event, Bateman and Zidonis have supplied some important insights into what the teacher of composition can teach and how this teaching will make a difference in the writing abilities of students.

STANLEY B. KEGLER
University of Minnesota

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The research reported herein was supported under the Cooperative Research Program of the Office of Education, United States Department of Health, Education, and Welfare.

This pamphlet is a condensation of the final report for Cooperative Research Project #1746, "The Effect of a Knowledge of Generative Grammar upon the Growth of Language Complexity," completed October 1964. The research design and the findings of that project seem to be of general interest to teachers of English and are reprinted here.

FRANK J. ZIDONIS
DONALD R. BATEMAN

Columbus, Ohio

FOREWORD

According to the theories of transformational generative grammar,[*] a careful description of the kernel sentences in English provides all the structures one needs in order to account for the formation of the complex structures. The phrase structure component *(kernel grammar),* though, must be developed in terms of the relationships that seem to hold between the simple and the complex structures. We hoped that the ideal kernel grammar would provide the simplest base upon which to construct the other components of the grammar in the simplest way. It was our intention to explore the rules of the kernel grammar in such a way that it would be possible to examine the transformational component of the grammar informally. The reason for treating the kernel grammar formally and the transformational rules informally is suggested by the somewhat specialized motivation of this study to provide an explication of a generative grammar that could be adapted to a study of stylistics in the junior high or high school English class. It is not our aim to make generative grammarians of the students, which would entail their writing generative grammars, but rather to help them become stylists who have expanded their capability of generating varied and well-formed sentences of the language. The requirement of learning how to reconstruct the transformational history of a complex sentence, which the student must learn to do in order to describe stylistic characteristics and well-formedness, is somewhat alien to a generative grammar, which generates sentences but does not analyze them. Consequently, one must understand how the grammar operates well enough to be able to reconstruct the steps through which a sentence has passed in its formation. Fairly extensive classroom exploration indicates that kernel grammar can be taught rather easily in a formal, explicit way; only in this formal way can the significant characteristics of the theory underlying the grammar be adequately explored. Furthermore, an explicit account of the kernel sentences introduces the student to many of the transformational rules since the close relationship between the simple and the complex provides the basis for defining the terms of the grammar. When students can clearly distinguish between kernel and non-kernel sentences, the reconstruction of complex sentences becomes a simple matter.

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[*] Those interested in the sources of generative grammar might examine Noam Chomsky's *Syntactic Structures* and his "A Transformational Approach to Syntax" in *Third Texas Conference on Problems of Linguistic Analysis in English;* Robert B. Lees' *Grammar of English Nominalizations;* and Charles Fillmore's Reports #1, 3, and 7 in *Project on Linguistic Analysis,* The Ohio State University Research Foundation.

The substantive materials that made up the experimental treatment are not reprinted here. Teachers interested in examining the kind of phrase structure and transformational components used by the investigators are referred to the final report of Cooperative Research Project #1746 (available from the Cooperative Research Division of the United States Office of Education), where a sketch of the materials appears. In the light of recent theoretical discussions in linguistics, the reader is reminded that grammatical materials developed for experimental study in high schools today might assume a radically different form—even in the transformational-generative tradition.

D.R.B.
F.J.Z.

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1. INTRODUCTION

Statement of Problem

Every composition teacher deals directly with the structure of English. Whether he relegates the role of language to a mere communicative function where it becomes a vehicle or a container into which the substance of content or ideas is poured or whether he believes that language can shape ideas as well as convey them, he must nevertheless have some means whereby he can talk about language with his pupils.

The "corrective grammar" of the typical high school language arts series, the earlier "functional grammar" which sought to present those bits of grammar that would solve usage problems, the "formal grammar" of the Lindley Murray and Bishop Lowth variety—all these have been tried extensively in American schools, with no discernible success. It now seems abundantly clear that these fragmented, prescientific grammars are only indirectly related to the structure of English. The classroom teacher of composition was unjustifiably optimistic in assuming that by studying the terms and concepts of these grammars his pupils would develop insight into the complex workings of English structures.

Thus even the teacher trained to use all the grammatical equipment available to him would not be able to help his pupils write better sentences. Good, acceptable, well-formed sentences are by definition grammatical sentences. The pseudo-grammars alluded to above do not account for the ways in which sentences are produced; in fact, they can offer no grammatical explanation for the process of sentence formation because they are classificatory schemes that deal only with already produced sentences. Structural grammar likewise shares this classificatory impediment. Though these various schemes do provide some sort of basic terminology by which teacher and pupils can discuss their writing, they are not held together by any linguistic theory that would provide some fuller understanding of the way language actually works. Moreover, they offer no grammatical basis for rejecting as a sentence a group of words like *The tree is remarkably intelligent*. A grammar should be fully able to account for the native speaker's ability to produce novel sentences in infinite variety. Grammars that fail to do so, or fail even to strive to do so, must be of dubious value for the classroom teacher of composition.

With the advent of generative grammar, which is in essence a representation of the psychological process of producing sentences, a logical approach to the study of composition has become available. It is the goal of a generative grammar to specify the well-formed and only the well-formed grammatical sentences of English. The composition teacher has always strived to get his pupils to write better sentences, but he has had no procedure whatsoever for explaining to them just what the concept *sentence* contains. A pupil who has only a vague notion of sentencehood is doubtless at a disadvantage in evaluating the quality of the sentences he has produced or in understanding the constructive criticisms of them offered by his teacher. Conscious control of well-formed sentences seems fundamental to the act of writing, but what is not understood can hardly be controlled. Pupils must be taught a system that accounts for well-formed sentences before they can be expected to produce more of such sentences themselves. It is the function of a complete grammatical system to define the concept of sentencehood; consequently all efforts to deal with punctuation, sentence fragments, and run-on sentences without recourse to an adequate grammar must fail. Fragments of grammars—functional grammar, for example—applied to specific problems of composition etiquette as *ad hoc* solutions simply reveal a misunderstanding of the role grammar might play in language study. Such excerpted bits of grammatical lore tend to be modernized forms of the discredited eighteenth century grammarian's authoritarian pronouncements: avoid splitting the infinitive, the subject of the gerund must be in the possessive case, do not end a sentence with a preposition. These pronouncements are based not on a theory of language so much as on the pontificator's understanding of the Graeco-Roman grammatical tradition. Their relevance for the English language is at least questionable; their usefulness in classroom study, highly suspect.

Granted that many purported grammars of English are inadequate and unscientific: Would the study of an adequate grammar of English prove worthwhile in the secondary school? Is the extant research conclusive in its failure to establish a correlation between the study of grammar and the improvement of pupil writing? The first question can be answered only empirically; the latter can rather justifiably be answered in the negative: Meckel (24),* surveying the research done on grammar and compositional problems, concludes that "much of the earlier research on teaching grammar must be regarded as no longer of great significance outside the period in educational history which it represents." Of greater importance for the present is his statement that "research does not justify the conclusion that grammar should not be taught systemically." Lumsdaine (23) explains why much of this now discredited research appeared to be definitive in its findings:

> failure to disprove the null hypothesis leaves the experimenter . . . no defensible position except that of suspended judgment . . . . The temptation is great to translate the only defensible statement of findings—namely, that the results merely fail to show evidence that there was a significant difference—into some more equivocal and more palatable form, e.g., that "no significant difference was found to exist" . . . or simply that "the two treatments did not differ significantly" (with that last word often deleted in the final summary. . .).

The present study seeks to measure the effect that the teaching of a generative grammar has upon the writing of ninth and tenth graders. The specific questions guiding the study are these:

1. Can high school pupils learn to apply the transformational rules of a generative grammar in their writing?
2. Can their repertoire of grammatical structures be increased by a study of generative grammar?
3. To what extent will the proportion of well-formed sentences increase in pupil writing over the two-year period?
4. What kinds of transformational errors will occur in pupil writing, and to what extent will such errors increase or diminish over the two-year period?

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*Numbers in parentheses refer to numbered items in the bibliography on pages 15-17.

Related Research

Current research in composition seems to have provided little of substance on which to build a sound program. Braddock (2), for example, in his comprehensive survey of the available research into written composition, concludes that today's research is "laced with dreams, prejudices, and makeshift operations." Much of the presently available research must be discounted. Meckel (24, p. 967) points out that there is now a substantial body of linguistic research and consequent insights into the nature of language in general and English in particular that "have caused many of the studies on the teaching of composition to lose the significance attributed to them in the past."

This substantial body of linguistic research may be subdivided into two kinds of systematic grammars: analytic and synthetic. Analytic grammars are prescientific in that they are classificatory and deal exclusively with limited samples of the language. Analytic grammars, according to Chomsky (3), have for their highest goal *observational adequacy*—a complete and error-free presentation of the data. Synthetic grammars, on the other hand, strive for the goal of *descriptive adequacy* when they account explicitly for the linguistic system underlying the data; they attain the highest goal, *explanatory adequacy,* to the extent that they are able to relate this linguistic system to a general theory of language. In the order of highest to lowest, linguists rank these goals as follows: 1) explanatory adequacy, 2) descriptive adequacy, and 3) observational adequacy.

In discussing procedures for evaluating grammars, Bach (1) demonstrates that the taxonomic and data collecting activities of traditional and structural grammars fail to meet the test of adequacy. In a review of Chomsky (5), Lees (21) deals extensively with the topic of grammatical adequacy. He concludes that the theoretical character of generative grammar and its consequent explanatory and predictive power promise to lead to new psychological insights into the nature of learning as well as more extensive understanding of the native speaker's capacity to produce an infinite number of the sentences of his language. Johnson (13-17) and Jenkins (11-12), in fact, are providing empirical evidence of the psychological reality of generative grammar theory. The hypothesis that the logical structure of a generative grammar is analogous to the psychological structure of the process of sentence production is becoming both speculatively and empirically compelling. Katz (18) further expounds the psychological reality of generative grammar theory. Hjelmslev (9) reasons, "*A priori* it would seem to be a generally valid thesis that for every *process* there is a corresponding *system* by which the process can be analyzed and described by means of a limited number of premises." As a model of the process of sentence formation, generative grammar should provide the most fruitful framework from which to investigate and modify the composing process.

Chomsky (5), Lees (20, 21), and Fillmore (6-8) have already made significant starts in the writing of a generative grammar of English. Though by no means to be considered complete grammars, these writings present a logical starting point for the study of language and composition. A pedagogical grammar, derivative from these four segments of grammars, was developed so that high school pupils in the present experiment could study the process of sentence formation. A set of forty-six rules has been used as the framework for describing the transformational history of the sentences that have been analyzed. This descriptive tool is an objective, largely mechanical device for identifying the grammatical components of each sentence produced. An analytical device of this sort could provide a scale of expected language growth for pupils at different grade levels. Such a scale would extend the earlier attempts of LaBrant (19) and Watts (26), who sought to provide a developmental scale of language growth within a pretraditional grammatical framework, and the later studies of Strickland (25) and Loban (22), who described the complexity of speech and writing within a structural grammatical framework. Hunt (10), though using a transformational description of sentence structure, does not distinguish between well-formed and malformed sentences; his findings consequently do not seem useful for the development of a scale that would chart expected sentence formation behavior at the different grade levels.

Much of the research which has investigated the relationship between a knowledge of grammar and compositional skill has construed *grammar* in a popular, prescientific sense. Scientifically oriented educators can hardly be surprised that the experimental classes exposed to the study of a prescientific—hence, inconsistent—English grammar did not produce significantly better results than control classes that did not study such a grammar. The only lesson to be derived from such comparisons seems to be that even the diligent study of an inconsistent body of materials is no better than the total abandonment of such study. What students are expected to learn and to apply is of utmost importance; yet this part of most experimental programs tends to be slighted—final reports of experiments seldom condescend to discuss this matter seriously. Does the frequent writing assignment prove to be superior to the infrequent one? Of course not: how could it be, unless something of substance was studied by the class? Is there any difference in student writing depending on whether the English teacher has a lay reader? Of course not: again, how could there be, unless something of substance was studied by the students? Ability grouping, changing (usually limiting) class sizes, alternating grammar study with literature study, teacher-student conferences over writing, team teaching approaches—most of these experimental investigations suffer from an understandable but fundamentally unsound assumption. They all assume that the English teacher has some valuable lessons to teach in his composition class, if only certain distracting realities could be removed. These distractions invariably are reducible to one: the English teacher is overloaded. The more likely assumption is that at present, in truth, the English teacher does not have lessons of value to teach to his composition students. Without a procedure for helping students to write acceptable sentences, no composition program is likely to be significantly better or worse than any other. It is consequently not the least surprising that most of these experiments have *inconclusive results,* though frequently they are inaccurately reported as having *negative results.* Readers of research reports must be alert for such statistical hyperbole.

The composition teacher, not having been provided with an adequate theory of language (or *grammar*), is forced to develop or secure curricular materials that will stimulate and challenge his students to write—hopefully, to write better. Disaffection with inadequate grammatical systems has led to the fairly widespread adoption of anthologies containing provocative essays which are intended to supply both topics for writing assignments and model sentences for student emulation. Again the role of the composition teacher becomes that of deadline-imposer, critic-reader, and theme grader. He seems to be incidental to whatever process it is that transforms a writer of fragments or poor sentences into a writer of acceptable prose. And he seems to be, unfortunately, a living indictment of researchers' failure to provide even modest support for the building of a suitable composition program. At the very least, such support would include the development of an adequate grammatical system.

Procedures

In order to test the possible effects of a study of a generative grammar upon pupil writing over a two-year period, the investigators selected the ninth grade class at the University School of the Ohio State University. The ninth grade, and the following year the tenth grade, seemed desirable because these two grades typically place the heaviest emphasis on grammatical study in the secondary schools. The fifty pupils constituting the ninth grade were assigned randomly to two sections. Teachers from the Language Arts Area of the University School were likewise assigned randomly to the two classes. Both teachers were experienced and highly competent; as it happened the control teacher had an edge in experience, having served one summer as a TV Demonstration Teacher and another as a Master Teacher in the Harvard Graduate School of Education. Each class studied what would be considered the regular curriculum at the school with this exception: the experimental class studied materials specially adapted by the investigators from the area of generative grammar. Of the original fifty subjects in this two-year project, the experimental class lost five and the control class lost four.

Frequently when an experimental class receives a substantive treatment that the control class does not receive, the investigator has serious problems in evaluation. In the new physics curriculum developed by the Physical Science Study Committee, for example, students are led to discover principles of material forces like energy and power through exploration in the laboratory instead of merely verifying there the traditional technology they had been taught in class. The objectives of the new physics program differ markedly from the objectives of the old one; clearly, a single test cannot provide a measure for comparing the achievement of pupils pursuing one curriculum with that of those pursuing the other. But the teaching of generative grammar to the experimental section in this study did not complicate the evaluation problem at all. For this substantive treatment was a means toward the achievement of objectives compatible with those of every English composition class: the improvement of pupils' writing. The experimental class was required to learn rather thoroughly the special grammatical materials prepared by the investigators; what the investigators had designed to measure, however, was the grammatical quality of the sentences produced by both sections at the initial and terminal stages of the experiment. To compute the grammatical quality of every sentence written in the samples of prose collected, the investigators developed an instrument of transformational analysis that could be applied in a reasonably mechanical way.

Written compositions were collected from both sections during the first three months of the first year and the last three months of the second year of the project. Both teachers met regularly with the investigators in order to standardize their writing assignments, which evolved by design out of their respective classroom concerns. One piece of writing was secured from each pupil approximately every two weeks during the collecting stages; thus each pupil produced on average twelve pieces of writing to be analyzed, six initially and six finally.

Prose Analysis

The investigators developed an analytical instrument that would objectively assess the grammatical quality of the sentences in the sample. According to the generative grammar espoused in this project, there are two kinds of sentences in English: kernel and complex. Transformational rules are used in order to produce all sentences other than kernel sentences. It seems possible therefore to describe the transformational history of the sentences in the sample by identifying the specific transformations used to form the complex sentences, all other sentences being by definition kernel sentences in this grammatical system. Forty-six transformational rules served to identify the grammatical operations that each sentence in the sample reflected. These rules are of four types: Embedding, Conjoining, Deleting, and Simple. Embedding transformations—the largest type, containing thirty-six rules—were further organized according to their specific functions: Noun Expansion, Noun Replacement, Adjective Expansion, Verb Expansion, Adverbial Replacement, and Adverbial Expansion.

EMBEDDING TRANSFORMATIONS

NOUN EXPANSION

1. Relative Clause (Be):
   I admire my English teacher, *who is a scholar.*
2. Adjective (by deletion and obligatory placement):
   A *handsome* lad.
3. Relative Clause (Have):
   The book, *which had no index*, proved useless.

4. With-phrase (by simple transformation of ET-3):
A book *with an index* is needed.
5. Relative Clause (V_b):
The boy *who scored the touchdown* was cheered.
6. Gerundive Adjective (by deletion and optional placement):
A *smiling* girl.
7. Compounds: He stepped into the *bull ring*.
8. Genitives: The *horse's* mouth/ The mouth *of the horse*.

Noun Replacement

9. That + S as subject:
That I am failing the course disturbs me.
10a. (That) S as object:
I know *he is a diligent student*.
10b. That + S as object:
I believe *that he has made the team*.
11. WH + S as subject:
What he has already learned astonishes me.
12. WH + S as object:
I know *what annoys him*.
13. WH + Inf as subject:
What to visit at the Fair is a problem.
14. WH + Inf as object:
My cousin knows *what to visit*.
15. Nominal Inf of Obligation:
Here is a book *for you to know*.
16. Inf as subject:
To appear on television is an exciting experience.
17. Inf as object:
I tried *to answer the question correctly*.
18. Inf of purpose:
The exercises are designed *to help you*.
19. Gerundive Nominal:
Tom's hot-rodding disturbed his mother./ She objected to *his continuous complaining*.
20. Gerundive Nominal of Purpose:
I have a knack for *getting into trouble*.
21. Abstractive Nominal.
His eagerness to depart surprised me./ I admired *the girl's reluctance to go*.

Adjective Expansion

22. Adjective + Inf: You are *free to get an education.*
23. Adjective + That-clause: I am *happy that you have enrolled.*
24. Adjective + Gerundive: Lures are *excellent for catching fish.*

Verb Expansion

25. V_{Ta}: I *caught him stealing the money.*
26. V_{Tb}: I *prevented him from stealing the money.*
27. V_{Tc}: I *advised him to return the money.*
28. V_{Td}: I *considered him to be the thief.*
29. V_{Te}: I *let him return the money.*
30. V_{Tf}: I *called him a fool.*
31. V_{Tg}: I *made him angry.*
32. V_{Th}: I *put the car in the garage.*
33. V_{in} + C: I *kept on talking.*

Adverbial Replacement

34. Adverbial Replacement in Loc, Tm, Mot, or Man:
    You may go *wherever you wish.*
35. Adverbial Replacement (ϕ):
    He is happy *because she smiled at him.*

Adverbial Expansion

36. Adverbial Expansion of *Man* + *C*:
    The lawyer spoke *so* rapidly *that he confused the jury.*

CONJOINING TRANSFORMATIONS

37. Conjoining: The boat sank *but* nobody drowned.

DELETING TRANSFORMATIONS

38. Common elements deletion:
    His lonely hotel room seemed cold and *his lonely hotel room seemed* damp.
39. WH + BE deletion: The boy *who is* starting at quarterback is in my class.
40. Adverbial embedment deletion:
    As if *he had been* asked, he sat down to dinner with us.

SIMPLE TRANSFORMATIONS

41. Passive:
    The boy hit the ball—*The ball was hit* (*by the boy*).
42. It-Inversion: *It is surprising that we won the game.*
43. There-Inversion: *There is a thief among us.*
44. Question: *Are you going to the game tomorrow?*
45. Negation: He *did not see* the mirage in the desert.
46. Negation-shift:
    I advised him not to enroll—I *didn't* (*did not*) *advise* him to enroll.

These forty-six grammatical structures are instrumental in the sentence evaluation techniques developed in the project, for they provide various scores for measuring the grammatical changes occurring over the two-year period in the pupils' writing. These structures, moreover, can be identified quite objectively in a sample of prose by analysts; and of course it is the use of these structures in writing that is measured—not the pupil's awareness of or ability to recall their labels. This particular means of sentence evaluation, therefore, is applicable to the writing produced in both the control and the experimental classes. It measures the grammatical quality of writing independent of the instruction accorded each class.

SENTENCE EVALUATION TECHNIQUES

The Sentence Evaluation Techniques (SET) consist of three component scores:

1. Structural Complexity Score (SCS)
2. Proportion of Well-Formed Sentences (PWF)
3. Error Change Score (ECS)

The SCS indicates the grammatical or structural richness of the sentences produced in the experiment; the PWF reveals the ratio of acceptable to unacceptable sentences; and the ECS shows the trend in the frequency and kinds of grammatical misoperations that occurred in pupil writing.

Structural Complexity Score

The forty-six transformations identified in the generative grammar adapted for this study were used to reconstruct the transformational history of every grammatical sentence in the prose sample. This process of reconstruction reverses the proper grammatical function of the transformations, whose effect is regularly to create new sentences rather than to analyze ones already produced. When sentences have been properly—that is, grammatically—formed, however, they can routinely be reduced to the kernel sentences from which they have been produced; and the transformations that have been applied can likewise be identified. The number of grammatical operations that have taken place in a particular sentence, then, becomes a score that characterizes the structural complexity of that sentence. The lowest possible score is *1*, which has been assigned to a kernel sentence; the score for a complex sentence becomes *1 + the number of transformations it contains.* Thus a sentence using two embedding transformations, one conjoining transformation, and one simple transformation receives an SCS of *5*. The following sentences, excerpted from the sample, illustrate further the computing of the SCS; the number in parentheses indicates the SCS, and the number above a particular word identifies one of the transformations as listed on pages 8 to 11:

(1) The rain splattered at the window.

(3) Then at long last I $\overset{29}{\text{could}}$ see the smoke rise from the chimney $\overset{8}{\text{of}}$ my house.

(5) $\overset{34}{\text{As}}$ these thoughts passed through my $\overset{7}{\text{now-numbed}}$ brain, I did $\overset{45}{\text{not}}$ notice the $\overset{2}{\text{dull}}$ rumbling in the distance.

(7) Her hands,^{1,39} long $\overset{37,38}{\text{and}}$ $\overset{7}{\text{delicate-looking}}$, have $\overset{7}{\text{almond-shaped}}$ fingernails.

(11) Finally the pawns, $\overset{5}{\text{whose}}$ initiative $\overset{37,38}{\text{and}}$ number provide a pattern $\overset{8}{\text{of}}$ battle, are the $\overset{2}{\text{brave}}$^{37,38} $\overset{6}{\text{protecting}}$ agents of the more $\overset{2}{\text{powerful}}$ forces $\overset{8}{\text{of}}$ the army, despite their lack of strength.

After every sentence was analyzed in this manner, the mean structural complexity score was computed for Before and After well-formed and malformed sentences for each pupil. The principal comparison was then made by analysis of variance applied to the gains scores.

Tabulating the specific transformations that occurred in every sentence of the sample made additional comparisons possible. What class of transformations—among the eight identified in the analytical instrument—was relied upon most heavily, for example? Which showed the greatest change between the Before-writing and the After-writing?

Proportion of Well-formed Sentences

The proportion of well-formed sentences was obtained by dividing the total number of sentences into the number of well-formed sentences for each subject in the study. To be considered *well-formed*, a sentence had to be both intuitively acceptable to the analysts and derivable from the rules of the grammar. Before a sentence was considered not well-formed, the analysts had to demonstrate that it could not be derived from the rules. Whether a sentence was well-formed or malformed, however, it was analyzed and assigned a structural complexity score. The following excerpt from one subject's prose illustrates how this part of the analysis was carried out:

(7) Later that day [8]Irea's Mother said, [10a]"[43]There's a [2]little girl
outside [5,39]waiting for you."

(1) Irea looked outside. (3) Yes, [43]there was a [2]little girl.
(6) [34]When Irea stepped outside, she [27]expected the [2]little girl
to go home, [37]but she didn't[45]. (10*) They played all afternoon,[37*]
[34]when the [2]little [8]girl's mother came, Susie[1,39] (the [2]little girl)
asked [12]if Irea could spend the night [37]and that was fine. (5)
[34]As Irea got into the car, she couldn't[45] believe her eyes;[37] Susie's[8]
father was Negro also. (3*) Now Irea belonged somewhere,[37*]
[35]she had a [2]real friend.

The number in parentheses preceding each sentence indicates the SCS for that sentence; the number above a particular word identifies the transformation being used. An asterisk following an SCS indicates a malformed sentence; an asterisk following a transformation number indicates that the transformation was misapplied. Of the seven sentences presented above, the five well-formed sentences have SCS's of (7), (1), (3), (6), and (5); and the two malformed sentences have SCS's of (10*) and (3*). In the first malformed sentence, the 37* indicates that the conjoining transformation was not properly applied though one was needed; in the second malformed sentence, the 37*-35 indicates that a conjoining transformation was improperly used for an abverbial replacement. Dividing the total number of sentences into the number of well-formed sentences in this severely limited example produces a PWF (Proportion of Well-formed Sentences) of .714.

Error Change Score

These five classes of errors—or grammatical misoperations—were identified and tabulated:

1. Misapplication of a transformational operation.
2. Use of one transformation when another is required.
3. Use of a transformation when none should have been used.
4. Omission of a required transformation.
5. Co-occurrence error: the use of mutally exclusive grammatical elements in kernel sentences or in kernel sentences underlying complex sentences.

Brief examples of the various classes of errors should be useful.

CLASS 1 ERROR:	In the sentence, "While Carson Drew was working on a case, he sometimes let his daughter help him, who does a very good job," Transformation 5 has been misapplied. The placement of the relative clause must come directly after *daughter*.
CLASS 2 ERROR:	Sentence (3*) above contains a Class 2 Error. The conjoining transformation was used instead of an adverbial replacement; one way of handling the sentence grammatically would have been to replace the comma with *because*.

Class 3 Error:	In the sentence, "Such ideas have and can be found in many books," a common element deletion—Transformation 38—has been applied to remove *been* after *have.* This transformation should not have been used.
Class 4 Error:	In the sentence, "He always looks clean though that's one thing in his favor," a conjoining transformation is omitted. A semicolon after *though* would have made the sentence grammatically acceptable.
Class 5 Error:	In the sentence, "As a youth, he was averse from reading his school assignments," *averse from* should have been *averse to.* A fragment like "The leaves falling from the trees," which does not have the complete verb phrase required by the phrase structure rules, also exemplifies this class of errors.

After all the occurrences of errors were identified for each subject in the study, the Before-scores were compared with the After-scores to determine what changes in error reduction had taken place.

BIBLIOGRAPHY

1. Bach, Emmon. *An Introduction to Transformational Grammars.* New York: Holt, Rinehart and Winston, Inc., 1964.
2. Braddock, Lloyd-Jones, and Schoer. *Research in Written Composition.* Champaign, Ill.: National Council of Teachers of English, 1963.
3. Chomsky, Noam. "Current Issues in Linguistic Theory," *The Structure of Language,* eds. Fodor and Katz. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964.
4. ———. "Explanatory Models in Linguistics," *Logic, Methodology, and Philosophy of Science,* ed. Ernest Nagel. Stanford, Calif.: Stanford University Press, 1962.
5. ———. *Syntactic Structures.* The Hague: Mouton and Company, 1956.
6. Fillmore, Charles J. *Desentential Complement Verbs in English.* The Ohio State University Research Foundation, GN 174, Report 1, April 1964.

7. ———. *Indirect Object Constructions in English and the Ordering of Transformations.* The Ohio State University Research Foundation, NSF-G18609, Report 1, February 1962.

8. ———. "The Position of Embedding Transformations in a Grammar," *Word,* 19, 2 (August 1963).

9. Hjelmslev, Louis. *Prolegomena to a Theory of Language.* Madison, Wis.: The University of Wisconsin Press, 1961.

10. Hunt, Kellogg W. *Differences in Grammatical Structures Written at Three Grade Levels.* Florida State University, Cooperative Research Project 1998, 1964.

11. Jenkins, J. J. "A Mediational Account of Grammatical Phenomena," *Journal of Communication,* in press.

12. Jenkins, J. J., and Palermo, D. S. *Mediation Processes and the Acquisition of Linguistic Structure,* Paper read at the Conferences on First-language Acquisition, Cambridge, October 1961.

13. Johnson, Neal F. *Linguistic Models and Functional Units of Language Behavior.* The Ohio State University, 1964, mimeographed, 41 pages.

14. ———. *The Influence of Associations Between Elements of Structured Verbal Responses,* Department of Psychology, Columbus, The Ohio State University, 1964, mimeographed, 10 pages.

15. ———. *The Integration of Subunits of Structured Responses.* Department of Psychology, Columbus, The Ohio State University, 1964, mimeographed, 7 pages.

16. ———. *On the Relationship Between Sentence Structure and the Latency in Generating the Sentence.* Department of Psychology, Columbus, The Ohio State University, 1964, mimeographed, 9 pages.

17. ———. *The Psychological Reality of Phrasestructure Rules.* Unpublished manuscript, The Ohio State University, 1963.

18. Katz, Jerrold J. "Mentalism in Linguistics," *Language,* 40, 2 (April-June 1964).

19. La Brant, Lou. "A Study of Certain Language Developments of Children in Grades Four to Twelve, Inclusive," *Genetic Psychology Monographs,* 14 (November 1933), 387-491.

20. Lees, Robert B. "The Grammar of English Nominalizations," Supplement to *International Journal of American Linguistics*, 26 (1960).

21. ———. "Review of Chomsky, *Syntactic Structures*," *Language*, 33, 3, Part 1 (July-September 1957), 376.

22. Loban, Walter. "Language Ability in the Middle Grades of the Elementary School." Final Report to the U. S. Office of Education, Department of Health, Education, and Welfare, 1961, mimeographed, 145 pages.

23. Lumsdaine, A. A. "Instruments and Media of Instruction," *Handbook of Research on Teaching*, ed. N. L. Gage. Chicago: Rand McNally Company, 1963.

24. Meckel, Henry C. "Research on Teaching Composition and Literature," *Handbook of Research on Teaching*, ed. N. L. Gage. Chicago: Rand McNally Company, 1963.

25. Strickland, Ruth G. "The Contribution of Structural Linguistics to the Teaching of Reading, Writing, and Grammar in the Elementary School," *Bulletin of the School of Education*, Indiana University, 40, 1 (January 1964).

26. Watts, A. F. *The Language and Mental Development of Children*. London: D. C. Heath and Company, 1944.

2. ANALYSIS OF DATA

The Writing Sample

Samples of writing were collected throughout the two-year period of the experiment. Approximately 70,000 words were analyzed. Before-samples were collected during the first three months of the experiment and After-samples were collected during the last three months. All writing was produced by the pupils as part of class assignments. In each class, improvement in pupil writing was one of the major objectives. The classes differed only in content: no formal grammar was studied in the control class; the grammatical content summarized in Chapter 1 was studied by the pupils in the experimental class.

Table 1

Total Words in Samples of Writing

	Control Class				Experimental Class		
	Before	After	Total		Before	After	Total
1	631	1687	2318	1	1124	968	2092
2	498	490	988	2	1233	722	1955
3	1258	732	1990	3	1844	765	2609
4	1057	706	1763	4	989	673	1662
5	707	980	1687	5	1357	1004	2361
6	673	737	1410	6	965	699	1664
7	653	1040	1693	7	705	268	973
8	674	575	1249	8	1417	894	2311
9	1070	1065	2135	9	777	951	1728
10	706	716	1422	10	1162	823	1985
11	625	907	1532	11	1105	1120	2225
12	688	1038	1726	12	915	390	1305
13	698	671	1369	13	1062	1103	2165
14	620	1356	1976	14	530	853	1383
15	627	1075	1702	15	745	799	1544
16	605	1218	1823	16	1455	1009	2464
17	672	1058	1730	17	515	903	1418
18	819	887	1706	18	430	1107	1537
19	779	704	1483	19	575	759	1334
20	1069	660	1729	20	754	803	1557
				21	550	570	1120
Totals	15,129	18,302	33,431		20,209	17,183	37,392

Table 2
Before and After Frequencies of Sentences and Transformations
Control Class

	Well-formed Sentences						Malformed Sentences					
	Before		After		Totals		Before		After		Totals	
	S's	T's	S's	T's	S's	T's	S's	T's	S's	T's	S's	T's
1	23	129	30	404	53	533	13	76	7	261	20	337
2	22	111	18	108	40	219	6	39	7	78	13	117
3	30	115	20	156	50	271	36	214	14	90	50	304
4	51	165	14	87	65	252	17	96	18	192	35	288
5	15	49	31	142	46	191	14	110	18	136	32	246
6	21	79	31	95	52	174	10	108	24	132	34	240
7	20	113	26	145	46	258	11	83	21	235	32	318
8	38	107	23	101	61	208	15	91	15	103	30	194
9	25	105	36	232	61	337	19	140	18	189	37	329
10	31	126	27	78	58	204	15	67	12	127	27	194
11	14	51	28	173	42	224	20	132	19	161	39	293
12	21	77	27	233	48	310	22	129	17	189	39	318
13	14	54	31	155	45	209	18	151	19	90	37	241
14	25	78	42	365	67	443	15	71	10	110	25	181
15	25	72	29	152	54	224	18	86	31	197	49	283
16	19	74	17	176	36	250	12	73	22	375	34	448
17	15	88	23	192	38	280	17	138	15	201	32	339
18	25	90	34	188	59	278	18	113	15	102	33	215
19	38	146	29	140	67	286	9	39	12	85	21	124
20	33	122	39	119	72	241	40	176	12	88	52	264
Totals	505	1951	555	3441	1060	5392	345	2132	326	3141	671	5273

Table 2 (Continued)

Experimental Class

	Well-formed Sentences						Malformed Sentences					
	Before		After		Totals		Before		After		Totals	
	S's	T's	S's	T's	S's	T's	S's	T's	S's	T's	S's	T's
1	29	151	35	197	64	348	22	150	2	15	24	165
2	18	95	24	161	42	256	25	210	5	51	30	261
3	32	151	18	172	50	323	32	253	8	73	40	326
4	49	152	52	183	101	335	24	97	3	13	27	110
5	20	71	41	208	61	279	27	247	10	78	37	325
6	25	120	31	223	56	343	26	128	6	54	32	182
7	10	47	48	247	58	294	19	177	2	8	21	185
8	36	176	43	283	79	459	23	171	1	3	24	174
9	29	121	50	340	79	461	19	84	2	11	21	95
10	15	48	52	236	67	284	27	233	6	29	33	262
11	38	225	46	449	84	674	11	88	3	77	14	165
12	36	141	22	84	58	225	16	79	9	48	25	127
13	38	183	47	313	85	496	16	106	4	79	20	185
14	6	21	29	131	35	152	14	92	11	158	25	250
15	20	101	24	198	44	299	17	95	8	70	25	165
16	44	399	44	346	88	745	9	87	1	17	10	104
17	23	66	65	276	88	342	18	93	1	2	19	95
18	28	88	49	382	77	470	2	3	2	5	4	8
19	10	32	42	225	52	257	23	134	4	69	27	203
20	23	93	56	222	79	315	17	87	4	48	21	135
21	27	49	21	148	48	197	24	66	7	57	31	123
Totals	556	2530	839	5024	1395	7554	411	2680	99	965	510	3645

The analysis of the prose consisted of a reconstruction of the transformational history of each sentence. A well-formed sentence had to be not only intuitively acceptable to the analysts but also grammatically derivable. A malformed sentence had to be not only intuitively unacceptable but also grammatically underivable. Analytical procedures were made as mechanical as possible. Summaries of frequencies of words, sentences, and transformations are presented in Tables 1 and 2.

Structural Complexity Scores

Each sentence in the sample was assigned a structural complexity score which represents the total number of grammatical operations it has taken to produce the sentence. Average structural complexity scores are presented in Tables 3 and 5.

The increase in average structural complexity scores for well-formed sentences was 3.793 for the control class and 9.315 for the experimental class. A difference of over 5 grammatical operations per sentence seems to indicate that the experimental class had significantly extended its capacity for producing complex well-formed sentences. However, a closer examination reveals that the greatest changes were made by only four students, one of whom shows a structural complexity increase of 64.741.

Table 3
Average Structural Complexity Scores for Well-formed Sentences

	Control Class				Experimental Class		
	Before	After	Change		Before	After	Change
1	8.791	27.300	+18.509	1	8.305	11.198	+ 2.893
2	8.162	11.759	+ 3.597	2	9.516	14.640	+ 5.124
3	6.298	9.744	+ 3.446	3	8.510	13.727	+ 5.217
4	5.333	11.333	+ 6.000	4	5.382	6.836	+ 1.454
5	5.796	7.732	+ 1.936	5	5.845	10.942	+ 5.097
6	7.190	6.842	− .348	6	7.908	10.986	+ 3.078
7	7.903	10.710	+ 2.807	7	8.340	8.126	− .214
8	4.972	7.851	+ 2.879	8	7.449	29.800	+22.351
9	8.086	10.526	+ 2.440	9	6.942	13.300	+ 6.358
10	7.571	5.077	− 2.494	10	5.521	9.080	+ 3.559
11	6.196	8.786	+ 2.590	11	8.822	24.951	+16.129
12	5.753	12.360	+ 6.607	12	7.702	6.167	− 1.535
13	6.740	11.322	+ 4.582	13	7.956	11.470	+ 3.514
14	5.103	13.896	+ 8.793	14	6.095	8.008	+ 1.913
15	5.917	8.645	+ 2.728	15	7.624	39.343	+31.810
16	6.378	15.051	+ 8.673	16	14.870	14.280	− .590
17	10.148	13.688	+ 3.540	17	5.576	8.217	+ 2.641
18	7.278	9.112	+ 1.834	18	5.966	70.707	+64.741
19	7.288	8.164	+ .876	19	5.969	13.476	+ 7.507
20	9.270	6.143	− 3.127	20	5.871	8.770	+ 2.899
				21	3.347	15.014	+11.667
Average	7.009	10.802	+ 3.793		7.310	16.625	+ 9.315

Statistical evaluation of change in average structural complexity scores for well-formed sentences by analysis of variance provides only minimal support for any contention that the increased average complexity scores in the experimental class can be attributed to the study of generative grammar.

Table 4
Well-formed Structural Complexity Scores: Statistical Summary

Source	df	SS	MS	F
D	1	192.15	192.15	3.01
S's w/gps.	39	2490.13	68.85	
A	1	898.81	898.81	28.47**
A x S's	78	2469.77	156.16	4.95*
A x D	1	156.16	31.57	

*Significant at the .05 level.
**Significant at the .01 level.

A: Before and After Scores
D: Control and Experimental Classes

FINDINGS:

1) Statistical analysis fails to indicate a significant difference between the control and experimental classes. (D)

2) Before and After Gains Scores are significantly different at the .01 level. (A)

3) The interaction between (a) Before and After Gains Scores and (b) experimental and control classes is significant at the .05 level. (A x D)

COMMENTS:

1) Increase in average structural complexity scores is significantly different when Before and After scores are compared independently of control and experimental groups. Both classes have increased capacities for producing sentences of greater complexity.

2) That the A x D interaction score is significant at the .05 level indicates that increase in structural complexity scores depends not only on when a sample was written but also on whether it was written in the experimental or the control class.

3) Though there is a suggestion that the greater gain in average structural complexity score for the experimental class is dependent on the study of the grammar, the failure of the statistical analysis to indicate a significant difference between the two classes (D) considerably weakens this contention.

The increase in average structural complexity scores for malformed sentences was 7.511 for the control class and 3.585 for the experimental class. Table 5 indicates that as both classes learned to write well-formed sentences of increased complexity they also increased the average structural complexity of malformed sentences, though the experimental class was better able to hold this tendency in check.

Table 5

Average Structural Complexity Scores for Malformed Sentences

	Control Class				Experimental Class		
	Before	After	Change		Before	After	Change
1	7.882	76.307	+68.425	1	9.973	8.800	- 1.173
2	10.000	19.795	+ 9.795	2	14.533	12.392	- 2.141
3	8.379	9.411	+ 1.032	3	12.553	13.233	+ .680
4	9.375	13.667	+ 4.292	4	7.103	5.692	- 1.411
5	10.148	11.765	+ 1.617	5	13.429	10.718	- 2.711
6	14.556	9.250	- 5.306	6	6.859	12.111	+ 5.252
7	9.711	21.298	+11.587	7	13.073	5.000	- 8.073
8	10.044	21.612	+11.568	8	11.678	4.000	- 7.678
9	14.621	15.757	+ 1.136	9	6.845	7.640	+ .795
10	7.224	15.528	+ 8.304	10	14.056	7.310	- 6.746
11	9.515	11.217	+ 1.702	11	10.045	36.650	+26.605
12	9.589	20.381	+10.792	12	6.385	7.792	+ 1.407
13	12.013	6.733	- 5.280	13	10.415	29.772	+19.357
14	7.986	12.982	+ 4.996	14	8.960	19.443	+10.483
15	8.337	11.036	+ 2.699	15	8.032	12.829	+ 4.797
16	16.658	24.717	+ 8.059	16	14.092	18.000	+ 3.908
17	11.819	17.353	+ 5.534	17	12.409	3.000	- 9.409
18	9.611	10.353	+ .742	18	2.667	4.400	+ 1.753
19	8.154	10.706	+ 2.552	19	8.746	24.812	+16.066
20	7.045	13.023	+ 5.978	20	7.200	25.792	+18.592
				21	5.000	9.965	+ 4.965
Average	10.133	17.644	+ 7.511		9.717	13.302	+ 3.583

Statistical analysis of average structural complexity scores for malformed sentences is unambiguous.

Table 6

Malformed Structural Complexity Scores: Statistical Summary

Source	df	SS	MS	F
D	1	115.98	115.98	1.50
S's w/gps.	39	3005.15	77.06	
A	1	620.24	620.24	12.02**
A x D	1	78.93	78.93	1.53
A x S's	78	4026.16	51.62	

*Significant at the .05 level.
**Significant at the .01 level.

A: Before and After Scores
D: Experimental and Control Classes

Findings:

1) The analysis fails to show a significant difference between the control and experimental classes. (D)

2) Before and After Gains scores are significantly different at the .01 level. (A)

3) The interaction between (a) Before and After Gains scores and (b) experimental and control classes is not significant. (A x D)

Comments:

1) Increase in average structural complexity scores for malformed sentences is significantly different when Before and After scores are compared independently of control and experimental classes. Both classes have increased average structural complexity scores significantly.

2) Since the analysis fails to show either a significant difference between the two classes (D) or a significant interaction effect (A x D), change in average structural complexity scores for malformed sentences cannot be said to be dependent upon the study of the grammar.

Proportion of Well-formed Sentences

Table 7 shows change in proportion of well-formed sentences. For the control class there is an increase of 3.5 percent; for the experimental class, 31.8 percent. It might seem unusual that the percentages of well-formed sentences in the Before writing were not higher (59.5% for the control class and 55.9% for the experimental class). These relatively low percentages reflect the rigor of the criteria for well-formedness. Customary compositional admonishments include such inexplicit judgments as "awkward," "vague," and other undefined terms that identify the grader's intuitive recognition of malformedness. In the analysis of the prose samples in this study, explicit grammatical demonstrations of intuitions of malformedness were required. It was not enough to recognize that a sentence was not well-formed: the exact character of the malformedness had to be explicitly attributed to malfunctions of phrase structure or transformational operations. A careful and detailed classification of errors led to a characterization of malformedness.

Table 7
Change in Proportion of Well-formed Sentences

	Control Class				Experimental Class		
	Before P	After P	Change		Before P	After P	Change
1	.639	.811	+.172	1	.569	.946	+.377
2	.786	.720	−.066	2	.419	.828	+.409
3	.455	.588	+.133	3	.500	.692	+.192
4	.750	.438	−.312	4	.671	.945	+.274
5	.517	.633	+.116	5	.426	.804	+.378
6	.677	.564	−.113	6	.490	.838	+.348
7	.645	.553	−.092	7	.345	.960	+.615
8	.717	.605	−.112	8	.610	.977	+.367
9	.568	.667	+.099	9	.604	.962	+.358
10	.674	.692	+.018	10	.357	.897	+.540
11	.412	.596	+.184	11	.776	.939	+.163
12	.488	.614	+.126	12	.692	.710	+.018
13	.438	.620	+.182	13	.704	.922	+.218
14	.625	.808	+.183	14	.300	.725	+.425
15	.581	.483	−.098	15	.541	.750	+.209
16	.613	.436	−.177	16	.830	.978	+.148
17	.469	.605	+.136	17	.561	.985	+.424
18	.581	.694	+.113	18	.933	.961	+.028
19	.809	.707	−.102	19	.303	.913	+.610
20	.452	.765	+.313	20	.575	.933	+.358
				21	.529	.750	+.221
Average	.595	.630	+.035		.559	.877	+.318

Analysis of variance applied to the gains scores for proportion of well-formed sentences provides the most unambiguous conclusions of the study.

Table 8
Proportion of Well-formed Sentences: Statistical Summary

Source	df	SS	MS	F
D	1	1.68	1.68	15.27**
S's w/gps.	39	4.34	.11	
A	1	3.82	3.82	119.38**
A x D	1	2.56	2.56	80.00**
A x S's	78	2.50	.032	

*Significant at the .05 level.
**Significant at the .01 level.

A: Before and After Scores
D: Experimental and Control Classes

FINDINGS:

1) There is a significant difference between the control and experimental classes at the .01 level. (D)
2) There is a significant difference between the Before and After scores at the .01 level. (A)
3) There is a significant interaction at the .01 level between (a) the Before and After scores and (b) the control and experimental classes.

COMMENTS:

1) The increased production of well-formed sentences by the experimental class is significantly greater than that of the control class.
2) The significant difference in the gains scores for proportion of well-formed sentences can unambiguously be attributed to the study of the grammar by the experimental class.

Error Change Scores

Tables 9-12 present changes in the frequency of the five classes of errors and total errors. Since the number of Before-sentences for both control and experimental classes is unequal to the After-sentences, the Before-frequencies for both classes have been adjusted so that Before-and After-tabulations can be meaningfully compared. Errors were classified as follows:

1. Misapplication of a transformational operation.
2. Use of one transformation when another is required.
3. Use of a transformation when none should have been used.
4. Omission of a required transformation.
5. Co-occurrence error: the use of mutually exclusive grammatical elements in kernel sentences or in kernel sentences underlying complex sentences.

Class 1 Errors

Table 9 shows Before- (adjusted) and After-frequencies of Class 1 Errors for control and experimental classes. Both classes were clearly able to reduce frequency of Class 1 Errors substantially. Average reduction for the control class was 8.9 (39.82%) and for the experimental class 13.67 (79.06%). The greater reduction made by the experimental class would appear to be clearly significant, though statistical analysis is not unambiguous.

Table 9

Change in Frequency of Class 1 Errors

	Control Class				Experimental Class		
	Before	After	Change		Before	After	Change
1	19	6	− 13	1	15	3	− 12
2	13	5	− 8	2	32	5	− 27
3	47	20	− 27	3	31	6	− 25
4	27	16	− 11	4	21	3	− 18
5	27	13	− 14	5	35	5	− 30
6	19	17	− 2	6	29	4	− 25
7	8	21	+ 13	7	25	1	− 24
8	15	7	− 8	8	17	1	− 16
9	24	14	− 10	9	10	1	− 9
10	16	8	− 8	10	33	2	− 31
11	35	14	− 21	11	5	2	− 3
12	34	11	− 23	12	8	2	− 6
13	31	22	− 9	13	14	4	− 10
14	19	3	− 16	14	16	15	− 1
15	11	15	+ 4	15	10	9	− 1
16	15	32	+ 17	16	9	1	− 8
17	16	14	− 2	17	20	1	− 19
18	23	11	− 12	18	2	1	− 1
19	6	10	+ 4	19	14	3	− 11
20	42	10	− 32	20	10	2	− 8
				21	7	5	− 2
Totals	447	269	−178		363	76	−287
Average	22.35	13.45	−8.9		17.29	3.62	−13.67

Percent of Error Reduction: 39.82% 79.06%

Table 10

Error Change Scores (Class 1): Statistical Summary

Source	df	SS	MS	F
A	2586.266	1	2586.266	33.536**
S (CD)	2930.521	38	77.119	
D	1094.934	1	1094.934	16.831**
A x D	115.286	1	115.286	1.772
A x S (CD)	2472.040	38	65.054	
Total	9199.046	79		

*Significant at the .05 level.
**Significant at the .01 level.

A: Before and After Scores
D: Experimental and Control Classes

Findings:

1) Before and After Gains Scores are significant at the .01 level. (A)

2) There is a significant difference at the .01 level between the control and the experimental classes. (D)

3) The analysis fails to show a significant interaction between (a) the Before and After scores and (b) the experimental and control classes.

Comments:

1) Decrease in production of Class 1 Errors is significantly different when Before and After scores are compared independently of control and experimental groups.

2) Even though the control and experimental classes differ significantly, the absence of a significant interaction weakens any contention that the experimental class's greater reduction of Class 1 Errors was a result of studying the grammar.

3) The clear relationship between increase in proportion of well-formed sentences and decrease in error production substantially supports the contention that the greater change of the experimental class is attributable to its study of the grammar.

Class 2, 3, and 4 Errors

The relative infrequency of errors in these classes suggested that statistical analysis would be undesirable. Table 11 shows Before- (adjusted) and After-frequencies of Class 2, 3, and 4 Errors. Class 2 Error reduction is the same for the experimental and control classes; the experimental class made considerably more Class 3 Errors in the Before-writing than the control class, though most of these errors were eliminated in the After-writing; the control class made considerably more Class 4 Errors than the experimental class, though it substantially reduced them in the After-writing. The lack of correspondence between Class 3 and 4 Before Errors makes any kind of comparison of the experimental and control classes impossible.

Table 11

Change in Frequency of Class 2, 3, and 4 Errors

	Control Class			Experimental Class		
	Before	After	Change	Before	After	Change
2	37	15	-22	38	16	-22
3	18	15	- 3	43	5	-38
4	61	14	-47	6	14	+ 8

Class 5 Errors

Table 12 shows Before- (adjusted) and After-frequencies of Class 5 Errors for control and experimental classes. Both the experimental and the control classes were able to reduce frequency of Class 5 Errors substantially. Average reduction for the control class was 6.55 (51.78%) and for the experimental class 10.48 (91.29%). The greater reduction made by the experimental class would appear to be clearly significant, though statistical analysis is again not unambiguous.

Table 12

Change in Frequency of Class 5 Errors

	Control Class				Experimental Class		
	Before	After	Change		Before	After	Change
1	3	2	- 1	1	10	0	-10
2	8	7	- 1	2	25	0	-25
3	13	1	-12	3	18	2	-16
4	13	3	-10	4	14	1	-13
5	13	12	- 1	5	23	1	-22
6	8	8	0	6	7	0	- 7
7	3	7	+ 4	7	8	0	- 8
8	11	12	+ 1	8	14	0	-14
9	0	5	+ 5	9	13	0	-13
10	15	5	-10	10	15	0	-15
11	31	4	-27	11	7	0	- 7
12	16	8	- 8	12	6	5	- 1
13	11	5	- 6	13	6	0	- 6
14	11	6	- 5	14	15	3	-12
15	10	6	- 4	15	15	2	-13
16	15	3	-12	16	0	0	0
17	13	4	- 9	17	8	0	- 8
18	15	17	+ 2	18	0	1	+ 1
19	5	4	- 1	19	10	1	- 9
20	39	3	-36	20	7	2	- 5
				21	20	3	-17
Total	253	122	-131		241	21	-220
Average	12.65	6.1	-6.55		11.48	1	-10.48
Percent of Error Reduction: 51.78%							91.29%

Table 13

Error Change Scores (Class 5): Statistical Summary

Source	SS	df	MS	F
A	1433.362	1	1433.362	41.509**
S (CD)	1312.175	38	34.531	
D	187.970	1	187.970	5.126*
A x D	78.749	1	78.749	2.148
A x S (CD)	1393.447	38	36.670	
Total	4405.703	79		

*Significant at the .05 level.
**Significant at the .01 level.

A: Before and After Scores
D: Experimental and Control Classes

FINDINGS:

1) There is a significant difference between the Before and After scores at the .01 level. (A)
2) There is a significant difference between the control and experimental classes at the .05 level. (D)
3) The analysis fails to show a significant interaction between (a) the Before and After scores and (b) the control and the experimental classes. (A x D)

COMMENTS:

1) Decrease in production of Class 5 Errors is significant when Before and After scores are compared independently of experimental and control classes.
2) Even though the control and experimental classes differ significantly at the .05 level, the absence of a significant interaction weakens any contention that the experimental class's greater reduction of Class 5 Errors is a result of studying the grammar.
3) The clear relationship between increase in proportion of well-formed sentences and decrease in error production substantially supports the contention that the greater change of the experimental class is attributable to its study of the grammar. The greater significance of difference between the experimental class and the control class in respect to Class 1 Errors (.01) as opposed to Class 5 Errors (.05)

suggests that the study of the grammar is more directly related to the reduction of Class 1 Errors. This tentative conclusion would receive logical support in that many co-occurrence errors seem to be pregrammatical, involving a failure on the part of the writer to channel a partially formed idea through the grammatical component of his sentence generating device.

Total Errors

Table 14 shows Before- (adjusted) and After-frequencies of total errors. The control class reduced errors by 46.63 percent and the experimental class by 80.86 percent. As in the case of both Class 1 and Class 5 Errors, statistical analysis of Total Errors does not yiald unambiguous results.

Table 14

Change in Frequency of Total Errors

	Control Class				Experimental Class		
	Before	After	Change		Before	After	Change
1	29	9	−20	1	31	4	−27
2	21	12	− 9	2	61	7	−54
3	82	21	−61	3	53	9	−44
4	44	22	−22	4	38	5	−33
5	45	27	−18	5	59	10	−49
6	32	29	− 3	6	38	6	−32
7	24	28	+ 4	7	37	2	−35
8	29	20	− 9	8	37	1	−36
9	29	22	− 7	9	25	2	−23
10	32	17	−15	10	55	6	−49
11	77	21	−56	11	11	4	−10
12	55	25	−30	12	18	11	− 7
13	47	27	−20	13	24	7	−17
14	34	10	−24	14	33	21	−12
15	26	45	+19	15	29	15	−14
16	32	18	−14	16	9	1	− 8
17	47	17	−30	17	28	1	−27
18	35	34	− 1	18	2	2	0
19	13	17	+ 4	19	41	5	−36
20	82	14	−68	20	22	4	−18
				21	36	9	−27
Totals	815	435	−380		690	132	−558
Average	40.75	21.75	−19.0		32.86	6.29	−26.57
Percent of Error Reduction:			46.63%				80.86%

Table 15

Error Change Scores (Total): Statistical Summary

Source	df	SS	MS	F
C	4	11022.898	2755.725	111.812**
D	1	538.770	538.770	21.860**
C x D	4	786.088	196.522	7.973**
S's w/gps	190	4682.731	24.646	
A	1	2079.944	2079.944	91.018**
C x A	4	1998.374	499.594	21.862**
D x A	1	56.078	56.078	2.453
C x D x A	4	188.516	47.129	2.062
A x S's w/gps	190	4341.808	22.852	

*Significant at the .05 level.
**Significant at the .01 level.

A: Before and After Scores
D: Experimental and Control Classes

Findings:

1) There are significant differences among the five classes of errors at the .01 level. (C)
2) There is a significant difference between the experimental and control classes at the .01 level. (D)
3) There is a significant interaction between (a) the classes of errors and (b) the experimental and control classes at the .01 level. (C x D)
4) There is a significant difference between the Before and After scores at the .01 level. (A)
5) There is a significant interaction between (a) the classes of errors and (b) the Before and After scores at the .01 level. (A x C)
6) There is no significant interaction between (a) the experimental and control classes and (b) the Before and After scores. (D x A)
7) There is no significant interaction between (a) the classes of errors, (b) the control and experimental classes, and (c) the Before and After scores. (C x D x A)

Comments:

1) Much the same comment can be made here as was made in regard to Class 1 and Class 5 Error reduction. The clear relationship between increase in proportion of well-formed sentences and decrease in error production substantially

supports the contention that the greater change of the experimental class is attributable to its study of grammar. The statistical analysis of total errors is somewhat obfuscated by the fact that the classes of errors factor (C) is a complex factor consisting of five subclasses. Consequently, significant differences are dependent not only on Before and After scores of experimental and control classes but also on the subclass of errors.

Proportions of Classes of Transformations in Well-formed Sentences

The detailed analysis of the prose samples included identification of every transformational operation in every sentence. Four data sheets were then prepared for each student (164 sheets): 1) Before well-formed sentences, 2) After well-formed sentences, 3) Before malformed sentences, and 4) After malformed sentences. Transformations were entered appropriately on each sheet in the position opposite the number of the specific transformation (1-46) and below the number representing the structural complexity score of the sentence in which the transformations occurred. Summaries were made according to the nine classes of transformations (Noun Expansion, Noun Replacement, Adjective Expansion, Verb Expansion, Adverbial Replacement, Adverbial Expansion, Conjoining, Deleting, and Simple) and proportions of classes of transformations were computed. Statistical evaluation of this information by analysis of variance indicated that there was a significant difference among the classes of transformations but that there was no significance between Before and After scores nor between the experimental and the control classes. In other words, it seems clear that the study of the grammar had no identifiable effect on the distribution of classes of transformations. Inspection of the data sheets suggests that further investigation of the frequency changes of individual transformations should be undertaken, though such an analysis of data is presently unfeasible.

Summary

The writing sample consisted of 70,823 words, 1,731 sentences, and 8,533 transformations. Before and After average structural complexity scores for well-formed and malformed sentences, Before- and After-proportions of well-formed sentences, Before- and After-frequencies of five classes of errors, and Before- and After-proportions of nine classes of transformations were evaluated by analysis of variance.

The following conclusions seem justifiable:

1) *Structural Complexity Scores of Well-formed Sentences*

Before and After Gains scores are significant at the .01 level, and the interaction score is significant at the .05 level. However, statistical analysis fails to indicate a significant difference between the control and the experimental classes.

No strong statistical claim can be made for attributing the greater gain of the experimental class to the study of the grammar, though inspection of the data (Table 3) and the consistently greater gains scores of the experimental class in the other comparisons is suggestive.

2) *Structural Complexity Scores of Malformed Sentences*

Since statistical analysis fails to indicate either a significant difference between the experimental and the control classes or a significant interaction effect, change in average structural complexity scores of malformed sentences cannot be said to be dependent upon the study of the grammar.

3) *Proportion of Well-formed Sentences*

Comparisons of Before and After scores, experimental and control classes, and interaction scores are all significant at the .01 level. The increase in production of well-formed sentences by the experimental class can unambiguously be attributed to the study of the grammar.

4) *Error Change Scores*

Comparisons of Before and After scores and the experimental and control classes are significant at the .01 level. However, the analysis fails to indicate a significant interaction effect. The clear relationship between increase in proportion of well-formed sentences and decrease in error production substantially supports the claim that the greater change of the experimental class is attributable to its study of the grammar.

5) *Proportions of Classes of Transformations in Well-formed Sentences*

When transformations were summarized by classes and changed to proportions, analysis of variance failed to indicate

a significant difference between Before and After scores and between experimental and control classes. The inconclusiveness of this analysis and inspection of the data sheets suggest that further investigation of frequency changes of individual transformations should be undertaken.

3. CONCLUSIONS AND IMPLICATIONS

It seems clear that claims must be presented tentatively, regardless of the statistical level of significance, when the total population was limited to forty-one pupils. Even so, the persistently higher gains scores for the experimental class in every comparison made strengthens the contention that the study of a systematic grammar which is a theoretical model of the process of sentence production is the logical way to modify the process itself.

It should also be observed that University School classes are most certainly atypical. Even though criteria of internal validity were adequately met through careful randomization procedures, the sampling requirements needed to meet criteria of external validity could not be adequately fulfilled. Consequently, it must be stated quite unequivocally that even though the net effect of the statistical analysis would strongly support the rejection of the null hypothesis that a knowledge of generative grammar is unrelated to change in structural complexity scores, proportion of well-formed sentences, and error reduction scores, generalizations that reach beyond the scope of the sample are purely speculative. However, any failure to meet rigorous criteria of external validity should not lead one to dismiss the statistically significant results of an experiment in which criteria of internal validity were carefully attended to. The persistent tendency of researchers to conclude that a knowledge of grammar has no significant effect on language skills (when judgment should have been suspended) should certainly be reexamined.

Since the experiment depended on a knowledge of generative grammar, the pupils in the experimental class had to be sufficiently intelligent to understand the subject matter of the two-year program. Randomization procedures and statistical analysis presumably take into account the individual differences within and between classes; nevertheless, some account of the relative intelligence of the two classes should be helpful in any final evaluation of the experimental results. Stanford-Binet Intelligence Quotient scores were available for all experimental class pupils and all but two control class pupils. The average IQ of the control class was 115 with a range of 91 to 153; the average IQ of the experimental class was 118.2 with a range of 88 to 153. Of greater interest, however, is the apparent lack of correlation between IQ and amount of increase in proportion of well-formed sentences as is shown in Table 16.

One further comment regarding the manner in which the generative grammar was taught seems important. The phrase structure component of the grammar was studied by the experimental class throughout the first year of the experiment. It was therefore not possible to present the transformational materials until the second year. Consequently, there was little time to explore the rhetorical applications of the grammar. Any great change in average complexity scores or in distribution of either classes of transformations or individual transformations would quite possibly have required more time.

Table 16

Intelligence and Before and After Proportions of Well-formed Sentences

	Control Class					Experimental Class			
	Before	After	Change	IQ		Before	After	Change	IQ
1.	.639	.811	+.172	(137)	1.	.569	.946	+.377	(138)
2.	.786	.720	−.066	(152)	2.	.419	.828	+.409	(112)
3.	.455	.588	+.133		3.	.500	.692	+.192	(096)
4.	.750	.438	−.312		4.	.671	.945	+.274	(128)
5.	.517	.633	+.116	(103)	5.	.426	.804	+.378	(134)
6.	.677	.564	−.113	(117)	6.	.490	.838	+.348	(104)
7.	.645	.553	−.092	(134)	7.	.345	.960	+.615	(123)
8.	.717	.605	−.112	(091)	8.	.610	.977	+.367	(115)
9.	.568	.667	+.099	(121)	9.	.604	.962	+.358	(138)
10.	.674	.692	+.018	(113)	10.	.357	.897	+.540	(097)
11.	.412	.596	+.184	(096)	11.	.776	.939	+.163	(122)
12.	.488	.614	+.126	(120)	12.	.692	.710	+.018	(124)
13.	.438	.620	+.182	(112)	13.	.704	.922	+.218	(153)
14.	.625	.808	+.183	(099)	14.	.300	.725	+.425	(088)
15.	.581	.483	−.098	(105)	15.	.541	.750	+.209	(115)
16.	.613	.436	−.177	(102)	16.	.830	.978	+.148	(133)
17.	.469	.605	+.136	(153)	17.	.561	.985	+.424	(094)
18.	.581	.614	+.113	(121)	18.	.933	.961	+.028	(112)
19.	.809	.707	−.102	(093)	19.	.303	.913	+.610	(103)
20.	.452	.765	+.313	(101)	20.	.575	.933	+.358	(128)
					21.	.529	.750	+.221	(127)

Conclusions of the Study

1. High school students can learn the principles of generative grammar relatively easily because of its consistency, specificity, and relevance to the notion of well-formedness.

2. A knowledge of generative grammar enables students to increase significantly the proportion of well-formed sentences they write.

3. Statistical analysis suggests, but does not prove, that there is a relation between a knowledge of generative grammar and an ability to produce well-formed sentences of greater structural complexity. Because the experimental subjects increased the average complexity scores in *well-formed sentences* to a greater degree than did the control subjects, and because the control subjects increased the average complexity scores in *malformed sentences* to a greater degree than did the experimental subjects, there is a strong inference that it was the knowledge of the generative grammar that enabled the experimental subjects to increase the complexity without sacrificing the grammaticality of their sentences.

4. When rigorous criteria of well-formedness are applied in the analysis of writing samples, results show that almost half of the sentences written by the ninth graders were malformed. This finding runs counter to the widespread contention of the structural linguist, who is not concerned with well-formedness as a grammatical goal, that children have acquired virtually full command of the grammar of English at an early age. The more likely contention is that the grammar of English is never fully mastered.

5. A knowledge of generative grammar can enable students to reduce the occurrence of errors in their writing.

Implications for Further Study

1. The changes in the writing of the experimental class strongly support the hypotheses that 1) generative grammar is a logical representation of the psychological process of sentence formation, and 2) understanding this process enables the student to write more grammatically. Further research in psycholinguistics and in the teaching of generative grammar may make it possible to identify not only a clearly defined set of psychological operations that have relevance to the composing process but also an analogous set of logical descriptions that would provide a significant structure for composition programs. At the same time it might also be possible to identify sets of

grammatical misoperations that characterize the writing of children at different age levels. A scale of expected compositional behavior for children of different ages could be constructed by using a detailed analytical device of the sort described in this study. The explicit description of grammatical operations and misoperations could then provide a basis for developing packages of compositional materials to be used at the different grade levels.

2. The use of transformational theory in developing instructional units for the experimental class focuses concern on the well-formedness or grammaticality of written sentences. Those analyses which list or identify all grammatical structures without distinguishing well-formed from malformed sentences—models from structural linguistics, for example—do not really provide the composition teacher with useful characterizations of grammaticality.

3. This analysis of prose made use of an instrument that identified forty-six transformational operations for producing sentences. The more precise the analytical instrument, presumably the more precise the description of writing will be. The corollary suggests that those attempts to relate maturity of written expression to a single index—like sentence length, clause length, frequency of subordinate clauses—are not likely to produce valid estimates of writing maturity, let alone precise descriptions of the writing.

4. Generalizations beyond this limited sample must be thought of as speculations. Nevertheless, it seems clear that this study provides a strong motivation for systematically investigating such speculations.

More immediate answers are needed to such questions as the following:

a) Could this study be replicated in communities which differ culturally and economically?

b) Could generative grammar be taught in the elementary grades?

c) If a class had more time to make systematic applications of the generative grammar to rhetorical matters, would there be greater differences in Before and After Gains Scores? The development of more economical methods for presenting a generative grammar to students clearly indicates that a pedagogically adequate generative grammar could be taught in much less than two academic years.

SOME CONCLUSIONS OF THIS STUDY

. . . A knowledge of generative grammar enables students to increase significantly the proportion of well-formed sentences they write.

. . . A knowledge of generative grammar seems to enable students to increase the complexity without sacrificing the grammaticality of their sentences.

. . . A knowledge of generative grammar can enable students to reduce the occurrences of errors in their writing.

. . . Because generative grammar seems to be a logical representation of the psychological process of sentence formation, understanding this process enables the student to write more grammatically.

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